U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1355
Rev. Feb. 1942

BLACKLEG

Its NATURE CAUSE *and* PREVENTION

BLACKLEG is a rapidly fatal, infectious disease which is confined to certain areas where the soil is infected with the blackleg organism. It affects especially young cattle (between 6 and 18 months old). Suckling calves under 6 months and cattle past 2 years old are rarely attacked. Cattle of improved breeding are more susceptible than common stock. Sheep, goats, and hogs may contract the disease occasionally, but man, horses, dogs, cats, and fowls appear to be immune.

The disease is characterized by high fever and the formation under the skin of gaseous swellings or tumors which emit a crackling sound on pressure. These swellings occur especially on the hind quarter or shoulder and usually cause lameness or stiffness. If they are lanced a frothy, dark-red fluid is discharged. Other symptoms are rapid breathing, suspension of rumination, and great depression. The disease nearly always terminates fatally in from 12 to 36 hours.

Blackleg is caused by a specific microorganism (germ) which produces spores (seeds) which are very resistant to destruction and may survive in the soil of a pasture for several years. Animals are infected through small punctures of the skin by thorns, briers, stubble, burs, barbed wire, etc.

Medical treatment is ineffective. Animals may be protected by injection with blackleg vaccine, several forms of which are on the market and may be procured from commercial sources. *The Department of Agriculture discontinued the distribution of blackleg vaccine July 1, 1922.*

Carcasses of animals which have died of blackleg should be thoroughly burned or deeply buried to prevent reinfection of pastures.

Washington, D. C.

Issued June, 1923
Slightly revised February 1942

BLACKLEG: ITS NATURE, CAUSE, AND PREVENTION.

By JOHN R. MOHLER, *Chief of the Bureau of Animal Industry.*

CONTENTS.

NATURE AND HISTORY OF THE DISEASE.

BLACKLEG (known also as black quarter, quarter ill, symptomatic anthrax, and emphysematous anthrax) is an acute infectious disease which attacks principally young cattle. It is characterized by swellings or tumors beneath the skin, due to gas formation in the tissues, usually accompanied with high fever. It follows a rapid course and nearly always results in death. The disease is more or less restricted to definite localities (such as pastures), where the soil is infected with the blackleg organism and where outbreaks may occur year after year unless prevented by vaccination.

Blackleg was formerly regarded as identical with anthrax, but there is little doubt that it has existed for many centuries and that a large number of outbreaks of destructive disease among cattle, referred to by early historians as anthrax, were really blackleg. This supposition is based on the fact that their description of the symptoms and post-mortem appearances in many cases corresponds more exactly to our present knowledge of blackleg than of anthrax. Investigations by various scientists in recent times have definitely proved the entire dissimilarity of the two affections from the standpoint of both cause and clinical appearance.

Following the work of Pasteur on anthrax, three other French investigators—Arloing, Cornevin, and Thomas—in 1879 proved that blackleg is caused by an entirely different organism and consequently is a distinct disease. The following year the same authors published a description of the blackleg organism and demonstrated that the disease could be produced in susceptible animals by inoculation and that immunity might be produced by introducing the organism into the circulation of such animals under certain favorable circumstances. This discovery was the beginning of a series of experiments which finally led to the introduction of preventive vaccination.

436171°—42

GEOGRAPHICAL DISTRIBUTION.

Blackleg occurs in nearly all parts of the world from which definite information regarding animal diseases is obtainable. The ravages of the disease are not confined to certain zones or altitudes, but occur as frequently in the extreme north as in tropical regions, and as often on mountain pastures as in the lowlands. It is therefore evident that the infection possesses great power of resistance to the destructive influences of varying climatic conditions.

In Europe blackleg occurs in Norway as far north as cattle are kept, also in Sweden, Denmark, Germany, the Netherlands, Belgium, France, Switzerland, Austria, Hungary, Italy, and Great Britain. On the summer pastures in the Alps in Switzerland, where for five months of the year the ground is covered with snow and ice, it has appeared regularly in summer when the cattle were brought from the lowlands and has been known to carry off as high as 25 per cent of the young stock. In France blackleg has been regarded as the most destructive disease among the cattle, and the greatest losses have been suffered in the dairy districts and on the mountain pastures.

In Africa blackleg occurs both in the northern and southern colonies, especially in the French possessions in Algeria, where it frequently decimates the herds of young stock. Also in the southern British provinces, especially Natal and the Transvaal, it has been reported to be very prevalent. The same seems to be the case with the English colonies in Asia, although no definite statistics are available. In South America the disease prevails extensively throughout Argentina and has been observed in Chile. Cattle in Cuba and Australia also suffer from it.

Investigations made and reports received by the Bureau of Animal Industry have shown that blackleg occurs in nearly all parts of the United States with the exception of the Southern Atlantic and Eastern Gulf States. The greatest losses have been suffered in the great cattle-raising and cattle-feeding regions of the West, bounded on the north and east by the Missouri and Mississippi Rivers and on the west by the Rocky Mountains, and including Texas, New Mexico, Oklahoma, Kansas, Nebraska, Colorado, North Dakota, and South Dakota. In the far West the disease prevails to a considerable extent also in Montana, Idaho, Washington, Oregon, California, Utah, and Arizona. In the East a number of outbreaks have been reported from Virginia, West Virginia, and Pennsylvania, and scattering outbreaks have occurred in Vermont, New York, Ohio, Kentucky, Tennessee, and North Carolina. In the Central States outbreaks have been reported from Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, and Missouri.

CAUSE AND MODE OF INFECTION.

The cause of blackleg is a microorganism known as *Clostridium chauvœi* (Fig. 1). These organisms, which are in the form of short rods, produce spores or seeds in one end, shown as light oval bodies in the illustration, giving the rods a club-shaped appearance. The relation of the rodlike organism to the spore is somewhat like that of a plant to its seed. The spore, like a grain of wheat or corn,

is very resistant to destruction by heat, cold, drying, or chemical disinfectants, while the form of the organism which corresponds to the plant is easily killed by these agencies. The spores may lie dormant for several years, in a pasture for instance, retaining their vitality, and still germinate and cause the disease when favorable conditions are presented. The blackleg germ belongs to the class of bacteria known as anaerobes, which develop only in the absence of oxygen.

The germs gain entrance into the body of the animal through abrasions or punctures of the skin, and perhaps in rare cases through the mucous membrane of the mouth, tongue, or throat. As it is necessary that air be excluded in order that the spores may develop, the introduction of the disease is favored by minute punctures carrying the organisms through the skin and into the underlying tissues, while cuts or open wounds are not favorable to its development even though the infection is present in abundance. Slight puncture wounds of the skin, such as those received from barbed-wire fences or from stubble, thorns, spines, briers, grass burs, or sharp or pointed parts of feed, seem to be the most likely method of infection, since they correspond most closely to the only manner in which the disease may be produced artificially, namely, by injection of the virus under the skin. Several observers have found the organisms in the mud of swamps. By placing a little of the mud under the skin the disease has been produced.

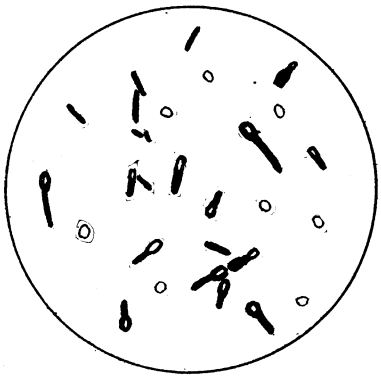

FIG. 1.—*Clostridium chauvœi,* the microorganism which causes blackleg. The light oval bodies as well as the light spots in one end of the organism are the spores (seeds). Magnified 1,000 times.

SUSCEPTIBILITY OF ANIMALS.

Every stock owner who lives in a district where blackleg occurs knows that it is the young cattle, especially those between the ages of 6 and 18 months, which are most liable to become affected. From a number of infected districts, however, it has been reported that the calves frequently begin to die at the age of 4 to 5 months, and cases of blackleg in even younger animals can not be considered exceedingly rare, although not numerous enough to be of practical importance. The increase in the number of cases with the increase in age is very characteristic, and suggests that natural or inherited immunity from blackleg, which is so pronounced in young animals, gradually wears off with the approach to the fateful half-year mark. It seems to be very unusual for cattle in the United States to contract the disease when past 2 years old. According to Swiss statistics (Hess) cows, when past 3 years old, are almost absolutely immune from blackleg.

As to the class of cattle most frequently affected by blackleg, the majority of reports agree that purebred or high-grade stock are more subject to the disease than common or low-grade cattle. In this country it was noticeable that blackleg began to increase when the stock owners began to improve their cattle. A large number of ranchmen have stated that their losses from blackleg were insignificant before they improved the breeding of their stock. In view of the nature of the disease and the manner in which the infection takes place, it seems that the more thin-skinned the animal the more liable it is to become infected, and that the thicker and tougher the skin the less likely is infection to occur. On large ranches where both ordinary and improved stock are kept it has been observed that the majority of deaths from blackleg occur among the better stock. The common range cattle of Texas and the Western States are very hardy, and it is probable that in regions where blackleg has prevailed for a number of years the native stock have acquired or inherited a partial or complete immunity from the disease.

Whether one sex is any more predisposed to blackleg than the other is very doubtful. A number of reports state that steer calves are more frequently affected than heifers, but the great majority of stock owners are of the opinion that both sexes are equally susceptible. In older animals there seems to be a greater susceptibility to blackleg among the males.

As to the condition of the animals, there seems to be a greater susceptibility in young cattle which are rapidly improving in flesh, as is the case when they are turned on fresh grass in the spring. On the other hand, the change from grass to hay in the fall in many localities seems to have an equally fatal effect on the stock. Some stock owners are inclined to attribute the appearance of blackleg to a lack of exercise, and state that driving the herd for a considerable distance will temporarily check the disease. There is reason to believe that lack of exercise while the grass is fresh and abundant is a predisposing factor in the appearance of blackleg.

Sheep and goats are subject to blackleg, and cases have been exceptionally reported in swine, but man, horses, dogs, cats, and fowls appear to be immune.

SEASONAL OCCURRENCE, WEATHER CONDITIONS, ETC.

The spring and the fall are the seasons most favorable for the development of blackleg. The disease is not confined to the seasons, however, but appears at all times of the year with more or less frequency. In the North, for instance in the Dakotas, the real blackleg season lasts from April to September or October, but outbreaks are reported in every month of the year. In Nebraska and Colorado the outbreaks are more evenly distributed over the whole year, with a slight increase in spring and fall, and the same may be said of Kansas. In Oklahoma and the Panhandle of Texas it is difficult to single out any season as being more favorable to blackleg than others; but in central and western Texas the greatest number of outbreaks occur during fall, winter, and spring, with but few cases during June, July, and August.

The occurrence of the disease in various parts of the world and under all sorts of climatic and weather conditions indicates that loca-

tion, geological formation, climate, and weather have no influence either favorable or unfavorable to the development of blackleg.

SYMPTOMS.

The symptoms of blackleg are so characteristic that the disease is easily recognized. The first symptoms may be either of a general or of a local nature, though more frequently the latter. The general symptoms are high fever, loss of appetite, and suspension of rumination, followed by great depression. Breathing becomes more rapid. The animal moves around with difficulty, frequently lies down, and, when water is near at hand, drinks at short intervals and but a little at a time. The visible mucous membranes are at first dark red and congested, but they change in the course of 12 hours to a dirty leaden or purplish color.

The most important characteristic of the disease is the development of a tumor or swelling under the skin. The swelling may appear on any part of the body and legs except below the knee or hock joint and on the tail. It is frequently seen on the thigh or shoulder, and, owing to the extensive discoloration of the swollen parts, as observed after the animal has been skinned, the disease has been popularly named "blackleg" or "black quarter." Tumors may also appear on the neck, the chest, the flank, or the rump. At first they are small and very painful. They increase rapidly in size and may in a few hours cover a large portion of the body. One or more of these tumors may form simultaneously and when in close proximity to one another may unite. The neighboring lymph glands become considerably swollen.

When slight pressure is made on a tumor, as in stroking or handling it, a peculiar crackling sound under the skin is heard. This is due to a collection of gas formed by the organisms as they multiply. At this stage the tumor is cool to the touch and painless in the center, and the skin over it is dry and parchmentlike. If the swelling is cut into, a frothy, dark-red fluid is discharged.

The swellings usually appear before the general symptoms, and they may even reach such an extent as to cause complete paralysis of the affected parts while the animal still looks bright and has a good appetite. This condition is, however, of short duration. As the swelling increases in size the general symptoms become more intense. The temperature may reach 107° F., while the respirations may exceed 140 a minute. The animal is unable to rise; the extremities become cold, and some time before death the temperature falls and may become subnormal. There is trembling of the muscles, which, as death approaches, may develop into violent convulsions.

The illustration on the title page shows the characteristic appearance of a yearling affected with blackleg as indicated by the swollen condition and lameness of the left hind leg.

With very few exceptions the disease terminates fatally, death generally occurring in from 12 to 36 hours after the first appearance of the symptoms. A few cases linger from three to four days, and the disease may occasionally terminate in recovery.

APPEARANCE AFTER DEATH.

The carcass of an animal which has died from blackleg soon becomes very much distended by gas, partially through fermentation in the intestines and partially through the formation of gas in the tissue under the skin. This distention, which is especially pronounced in the region of the blackleg tumors, extends for a considerable distance from the tumors and in the directions where it meets the least resistance—that is, where there is plenty of loose tissue. This is especially the case on the back and sides of the chest, on the shoulder, between the shoulder and the chest, and on the outer surface of the hind quarter. This inflated condition frequently causes the two legs on the upper side of the carcass to stand out straight without touching the ground, as shown in Figure 2.

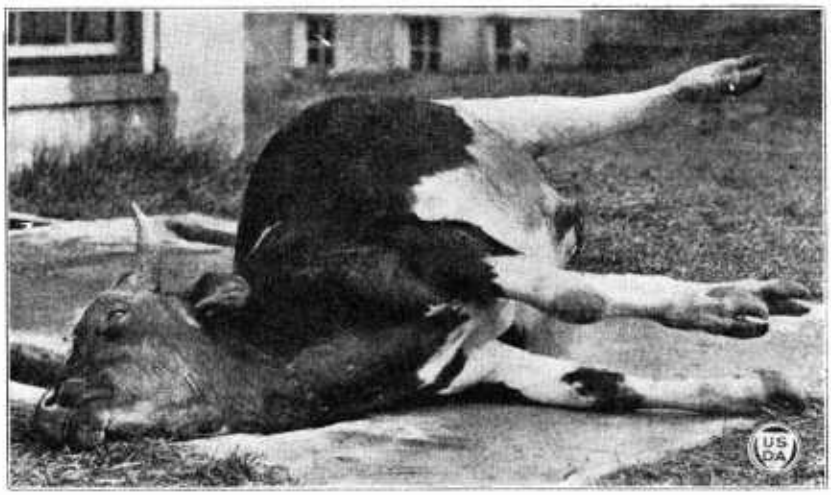

FIG. 2.—Yearling dead of blackleg, showing swollen condition of left hind leg and characteristic "propped-up" appearance of legs.

A dark, blood-colored, frothy discharge flows from the nostrils and the anus. Decomposition takes place soon after death, except in the affected muscles, which retain a sweetish-sour odor without developing any putrid odor, even when the rest of the carcass has decomposed.

On the surface of the body may be seen one or more of the characteristic blackleg tumors. The skin covering these swellings is affected with dry gangrene. The connective tissue beneath the skin is infiltrated with blood and bloody serum and is distended with gas. The distended muscles are dark brown or black, are easily torn, and the spaces surrounding them are filled with bloody liquid and gas. The muscle tissue is distended with numerous smaller or larger gas-filled cavities, often to such an extent as to produce a resemblance to lung tissue. (See Fig. 3.) Upon incision it does not collapse perceptibly, as the gas cavities are not connected with one another. The discoloration is deepest at the center, shading off toward the edges, and becomes brighter by contact with the air. On compression thick blood escapes, which is charged with gas and has a disagreeable odor, somewhat like that of rancid butter. The blood in the remain-

ing parts of the carcass is normal and coagulates easily after death, forming a solid clot. The abdominal cavity sometimes contains a considerable quantity of bloody effusion. The mucous membrane of the intestine may be congested or inflamed, and the contents of the bowels may be covered with blood. Blood spots are found also on the heart and lungs. The liver is congested, but the spleen is always normal.

DISTINGUISHING BLACKLEG FROM OTHER DISEASES.

Among the features of blackleg which distinguish it from anthrax may be mentioned the unchanged spleen and the ready clotting of the blood. It should be remembered that in anthrax the spleen is very much enlarged and the blood is tarry, coagulating feebly. The anthrax carbuncles and swellings differ from the blackleg swellings in not containing gas, in being hard and solid, and in causing death less rapidly.

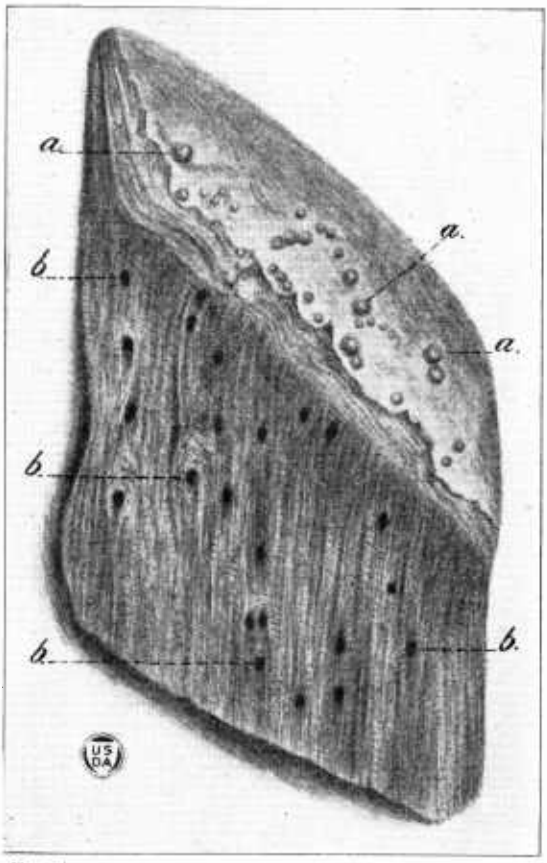

FIG. 3.—Section of muscle from a blackleg swelling. Gas bubbles (*a*) and cavities due to gas formation (*b*) are shown. The muscle is dark red in color.

It is difficult to distinguish between the swellings of blackleg and those of malignant edema, as they resemble each other very closely, and both are distended with gas. Malignant edema, however, generally starts from a wound of considerable size. It often follows surgical operations, and does not result from the small abrasions and pricks to which animals are subjected in pastures.

Hemorrhagic septicemia may be differentiated from blackleg by its affecting cattle of all ages, by the locations of the swelling usually about the region of the throat, neck, and dewlap, by the soft, doughy character of these swellings without the presence of gas bubbles, and finally by the characteristic hemorrhages widely distributed throughout the body.

Bacteriological tests, including microscopic examination of diseased tissues and inoculation of test animals, afford the most reliable means of distinguishing between infectious diseases and identifying infection, but such methods can be utilized only by the trained bacteriologist or veterinarian. Inoculation experiments on guinea pigs, rabbits, and chickens will disclose the differences between blackleg, anthrax, and malignant edema, as all these species are killed by the germ of malignant edema, but only the first two by the anthrax germ, while the guinea pig alone succumbs to the blackleg infection.

TREATMENT.

Medicinal treatment has thus far proved unavailing in the treatment of blackleg. Some writers have recommended the use of certain drugs, which have seemed to be beneficial in a few cases, but a thorough trial has shown them to be valueless. Others have advised that the swelling be opened by deep and long incisions and that a strong disinfectant, such as a 5 per cent solution of carbolic acid, be applied to the wounds. Such a procedure can not be too strongly condemned. As nearly all the animals attacked die in spite of every kind of treatment, and as the opening of the tumors scatters the germs over the stables or pastures and causes danger to other animals, it is obvious that such measures do more harm than good and should be discarded as dangerous.

Other methods formerly practiced but not now generally favored are bleeding, "nerving," setoning or roweling, and violent exercise. "Nerving" is a term applied to severing the artery between the hoofs. Setoning or roweling consists in producing a large running sore in the dewlap or on the shoulder by the insertion of a piece of tape or other suitable substance, thus draining the animal's vitality. This method has been used extensively in England, where public opinion was opposed to vaccination, but leading English veterinary authorities consider it useless. The evidence indicates, in fact, that none of these measures have either curative or preventive value, while they are open to objection on the ground of cruelty.

The only effective and reliable means known for protecting animals against blackleg is vaccination, which has been thoroughly tried and proved to be efficacious.

VACCINATION.

The three French veterinarians already mentioned (Arloing, Cornevin, and Thomas) devised a method of inoculation with attenuated (weakened) blackleg spores which produce immunity from natural or artificial inoculation of virulent blackleg germs. Their method of vaccination, which became popularly known as the French method, the Arloing method, or the Lyons method (their laboratories are located at Lyons, France), was introduced in 1883 and was generally adopted during the following two years. According to this method the material used for vaccine is obtained from a fresh blackleg tumor, and after being dried and ground into a powder it is mixed with water to make a dough, spread on thin plates, and attenuated by heating in an oven to a temperature of 100 to 104° C. for seven hours. The material is then pulverized,

mixed with water, and injected under the skin of calves, producing a partial immunity. This immunity is later reinforced after 8 or 10 days by a second injection of a vaccine which has been heated for the same length of time but at a temperature of 90 to 94° C.

Later Kitt, a German scientist, modified the French method so that but one injection of vaccine was required instead of two. The Kitt method was further modified by Nörgaard, of the Bureau of Animal Industry, in 1896, by heating the virus to 94 or 95° C. for six hours, and this modification was used for many years by the Bureau of Animal Industry in the preparation of Government powdered vaccine. Vaccines prepared after the above-mentioned methods are put out in the usual pellet or powdered form.

Other improved methods of protecting cattle against blackleg include the use of forms of vaccine known as aggressins and filtrates. Experiments by Roux and also by Duenschmann in Europe and by Schöbl in the United States proved that a natural aggressin, prepared from the juices derived from blackleg lesions and made sterile by filtering through porcelain, possesses highly satisfactory immunizing properties. Similar experiments by Haslam and Franklin, of the Kansas Experiment Station, on large numbers of cattle showed that this germ-free product is highly efficient. This aggressin is now being produced very extensively in the United States and gives excellent results, as it confers an effective protection to treated animals without producing any vaccination disease.

Nitta, of Japan, has developed an artificial aggressin, which is known as germ-free blackleg filtrate. This agent is prepared by growing blackleg organisms in a special medium until the fluid becomes saturated with their products. The fluid is passed through porcelain filters to make it germ free and treated with phenol to preserve it. The results obtained from this filtrate have likewise been very satisfactory.

Franklin, of Texas, developed a method of producing a bacterin for the prevention of blackleg. This method yields a sterile product incapable of producing blackleg or other diseases and possessing high immunizing value. The product consists of killed cultures of the blackleg organism suspended in the medium in which it was grown. Thus it not only contains the products of growth as does the germ-free blackleg filtrate, but also the dead organisms themselves.

The principal advantage of these new immunizing agents is the impossibility of producing the disease itself in the treated animals, but, as a rule, they are somewhat more expensive than the powder vaccine.

Antiblackleg serum is also being produced for treating calves already affected with blackleg, as well as for producing a passive immunity in exposed animals of an infected herd. This serum is prepared by inoculating horses with repeated injections of washed cultures of the blackleg organism into the veins and later under the skin, and afterwards drawing the blood to obtain the serum. This product, however, is rarely used at the present time in the United States.

Directions for the use of blackleg vaccine accompany the packages and should be closely followed. In order to avoid danger from complicating disorders, it is well to refrain from castrating, spaying,

and dehorning at the time of vaccination. When animals to be vaccinated are gentle and accustomed to being handled, vaccination may be performed on the standing animal. Range cattle or other half-wild animals must be thrown or otherwise secured—as, for example, in a chute such as is used for branding or dehorning. The immunizing properties of vaccine are not usually imparted until 10 or 12 days after vaccination. As vaccine is thus a preventive and not a curative agent, it is not advisable to vaccinate an animal after the symptoms of blackleg have developed, though the serum mentioned above, if available at the onset of the disease, might be efficacious in such cases.

Vaccination is generally followed by insignificant symptoms. In some cases there is a slight rise in temperature, and sometimes a minute swelling may be noted at the point of injection.

The immunity conferred by vaccination may vary to some extent, but is generally believed to last from 12 to 18 months or longer. Calves 6 months of age or older when properly vaccinated against blackleg usually do not require further treatment. Animals vaccinated before they are 6 months old and those in badly infected districts should be revaccinated before the next blackleg season.

For the vaccination of calves against blackleg there are at present a number of recognized immunizing agents available in the United States, namely, blackleg cultural vaccine, blackleg tissue vaccine (in pellet form), blackleg cultural aggressin (in disk or liquid form), blackleg natural aggressin, blackleg bacterin, and antiblackleg serum.

The Bureau of Animal Industry has conducted no experiments to determine the relative immunizing value of different types of blackleg biologics, but reports from the field of practice indicate that any of these immunizing agents when properly administered give excellent results in the prophylactic vaccination of cattle against blackleg.

DISTRIBUTION OF GOVERNMENT VACCINE DISCONTINUED.

In 1897 the United States Department of Agriculture began the preparation and free distribution of blackleg vaccine to stock raisers. Up to that time the "single vaccine" could not be obtained in this country. The effect of vaccine in preventing losses and in reducing the prevalence of blackleg was highly satisfactory. In the 25 years of Government distribution about 47,000,000 doses were supplied. Reports indicated that as a result of the use of the vaccine the losses from blackleg were reduced from about 10 per cent to less than one-half of 1 per cent of the number of calves produced annually in the infected districts.

The distribution of the Government blackleg vaccine was discontinued July 1, 1922, in compliance with the following provision of the act of Congress making appropriations for the work of the Department of Agriculture for the year beginning with the date named: "*Provided further*, That no part of this sum shall be used for the manufacture, preparation, or distribution of blackleg vaccine."

PREVENTING AND DESTROYING INFECTION.

HOW INFECTION IS SPREAD.

When blackleg occurs with more or less regularity in a pasture, feed lot, or stable, it is due to the presence of the blackleg germ either in the ground of these places or in materials (coarse feed, etc.) brought there regularly. Whenever an animal becomes affected the germs multiply by the million in its system, and their liberation, through natural or artificial means, tends to preserve, increase, or spread the infection. When attempts are made to "doctor" affected animals by opening the swellings the infection is scattered with the bloody discharge. Infection may be spread over wide areas by dogs, wolves, coyotes, and buzzards which attack and devour the carcasses of animals that have died of blackleg.

It is therefore of the utmost importance that cattle owners in infected districts realize that an animal affected with blackleg may be the cause of large subsequent losses from the same disease, perhaps not immediately, but within a period of years to follow; and it can not be too urgently recommended that they make every effort to reduce the danger by taking adequate measures to destroy as completely as possible this source of renewed infection.

PROPER DISPOSAL OF CARCASSES.

Where wood is plentiful the best method of destroying an infected carcass is to burn it. In order to insure its complete destruction the dead animal should be placed on two logs and plenty of dry wood heaped around it. About two quarts of kerosene should then be poured on and fire set to it. It is necessary that the carcass be entirely destroyed; if any part of it remains, another fire should be built around it.

In a pasture where wood is scarce the carcass may be buried. This method is more or less unsatisfactory, as the infection is not destroyed, but merely removed to a few feet below the surface, whence it may return through various means, for instance, as demonstrated by Pasteur, through the agency of earthworms. It is therefore of importance that the hole in the ground be made at least 6 feet deep and the carcass well covered with quicklime before the earth is filled in. A place should be selected that is free from danger of contaminating the water supply. The place where the animal was lying before being buried, as well as the top of the grave, should be freely sprinkled with a strong disinfecting solution, such as compound solution of cresol (at least 4 ounces to the gallon of water) or one of the recognized commercial coal-tar dips or disinfectants.

Because of the difficulty of destroying the infection it is well to kill an affected animal as soon as the disease has been definitely determined to be blackleg, and to burn the carcass immediately without removal. The fresh virus is much more easily destroyed than the dried, and by quick action a better result is always assured. If an animal dies from blackleg in a stable, it becomes necessary to remove

the carcass to a proper place for burning or burial. Care should be taken to scatter straw or hay wherever there is a possibility of infecting the stable floor or the ground with the discharges from the carcass while it is being removed. All litter should be removed from the stable and burned, together with that used in removing the carcass. The woodwork and floors of the stable should be thoroughly and repeatedly soaked with a disinfectant of the kind already mentioned.

FREEING PASTURES OF INFECTION.

The eradication of blackleg infection from pastures is difficult. The method of preventing the renewal of infection by keeping susceptible animals away from a pasture until the infection has died out, which is effective against some diseases, is impracticable in the case of blackleg because of the long time that the spores retain their vitality. Outbreaks of blackleg have been reported as appearing in pastures where no previous case had occurred for 11 years. Few persons can afford to keep a pasture unstocked for a sufficient length of time for the infection to die out. A change of stock from one pasture to another is likely to be ineffective because as a rule the conditions are very much alike in all pastures on the same farm or ranch.

It has been asserted that complete drainage and cultivation of the soil for several years will prevent further outbreaks, but where the question concerns large pastures which are unsuitable for anything but cattle raising this measure is, of course, out of consideration.

One of the most effective methods for freeing a pasture from blackleg infection is to allow the grass to grow high and when it is sufficiently dry to burn it off. One burning is not sufficient to destroy all infection; hence the process should be repeated several years in succession. This method, however, is often impracticable, as but few cattle owners can afford to carry it out.

After all it appears that immunization by means of vaccination is the only known practicable and effective means, not only of protecting individual animals against blackleg, but, by repeated application year after year, of eventually ridding pastures of infection by preventing the development of new cases during the long period necessary for the old infection to disappear.

U. S. GOVERNMENT PRINTING OFFICE: 1942

For sale by the Superintendent of Documents, Washington, D. C. - - - - Price 5 Cents